

Power-by-Wire Development and Demonstration for Subsonic Civil Transport

During the last decade, three significant studies by the Lockheed Martin Corporation, the NASA Lewis Research Center, and McDonnell Douglas Corporation have clearly shown operational, weight, and cost advantages for commercial subsonic transport aircraft that use all-electric or more-electric technologies in the secondary electric power systems. Even though these studies were completed on different aircraft, used different criteria, and applied a variety of technologies, all three have shown large benefits to the aircraft industry and to the nation's competitive position.

The Power-by-Wire (PBW) program is part of the highly reliable Fly-By-Light/Power-By-Wire (FBL/PBW) Technology Program, whose goal is to develop the technology base for confident application of integrated FBL/PBW systems for transport aircraft. This program is part of the NASA aeronautics strategic thrust in subsonic aircraft/national airspace (Thrust 1) to "develop selected high-leverage technologies and explore new means to ensure the competitiveness of U.S. subsonic aircraft and to enhance the safety and productivity of the national aviation system" (*The Aeronautics Strategic Plan*). Specifically, this program is an initiative under Thrust 1, Key Objective 2, to "develop, in cooperation with U.S. industry, selected high-payoff technologies that can enable significant improvements in aircraft efficiency and cost."

March 17 to 19, 1992, NASA held a requirements workshop at the NASA Langley Research Center which included 95 representatives from many of the companies interested in the FBL/PBW program and representatives from the Government. The PBW panels made recommendations that were incorporated into the PBW program, including (1) complete a system requirements definition study, (2) keep the distribution frequency in the midrange (400 to 1200 Hz), (3) raise the distribution voltage from 110 to 440 V, (4) consider a technology freeze in fiscal 1996, and (5) provide sufficient realistic flight demonstrations.

The objective of this PBW program, which began in 1993, is to develop and demonstrate the technology for a more-electric secondary power system and to provide enough confidence in this technology through testing that the airline industry will begin to transfer this technology into the civil fleet. This more-electric secondary power system will provide all the functions formerly performed by the hydraulic and pneumatic systems. The PBW program also will build a contractor and subcontractor base to support the PBW technology.

In the first phase of the PBW program, power system definitions and requirements will be developed. A power management and distribution (PMAD) architecture that best meets the system requirements will be designed, fabricated, and tested. Several electrical actuators will be designed, fabricated and demonstrated; and a starter/generator that best

meets the system requirements will be designed, fabricated, and demonstrated.

A redundant electrical actuator subsystem developed under the PBW portion of the FBL/PBW program will be delivered to Langley to be integrated into the Transport Systems Research Vehicle (TSRV) 757 for a flight demonstration in 1999. The flight demonstration will consist of a fault-tolerant control subsystem, a fault-tolerant power subsystem, an electrical actuator subsystem, and optic sensors.

A PBW program contract was signed with McDonnell Douglas in September 1993, the specifications and requirements documents were completed and delivered in April 1995, the preliminary flight actuator design was completed in July 1995, and a preliminary design review of the program was completed in November 1995.